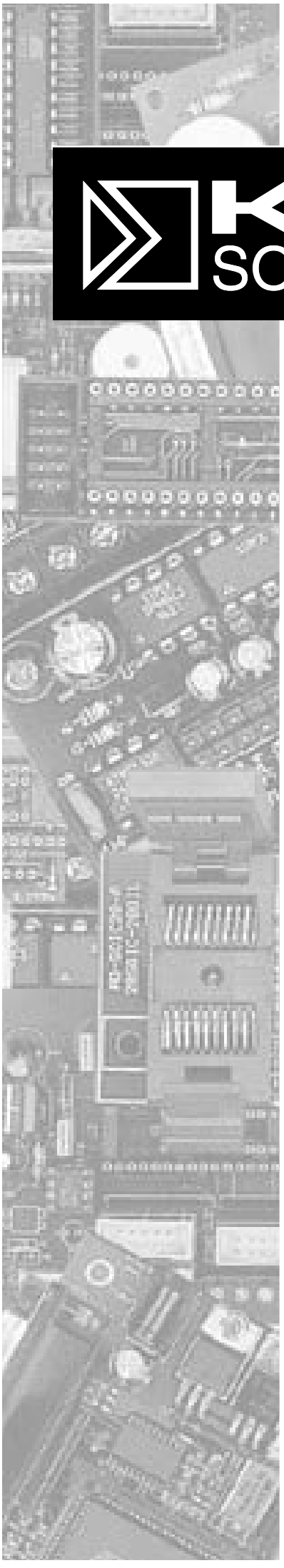
DatasheetDirect.com

Your dedicated source for free downloadable datasheets.

- Over one million datasheets
- Optimized search function
- Rapid quote option
- Free unlimited downloads

Visit www.datasheetdirect.com to get your free datasheets.

This datasheet has been downloaded by http://www.datasheetdirect.com/



KEIL SOFTWARE

PK51

Integrated Development System for the 8051

PRODUCT OVERVIEW

(Preliminary Manual)

EQUINOX TECHNOLOGIES

EQUINOX TECHNOLOGIES UK LIMITED

The Embedded Solutions Company

Copyright Information

Information in this document is subject to change without notice and does not represent a commitment on the part of the manufacturer. The software described in this document is furnished under license agreement or nondisclosure agreement and may be used or copied only in accordance with the terms of the agreement.

It is against the law to copy the software on any medium except as specifically allowed in the license or nondisclosure agreement.

The purchaser may make one copy of the software for backup purposes. No part of this manual may be reproduced or transmitted in any form or by any means, electronic, mechanical, including photocopying, recording, or information retrieval systems, for any purpose other than for the purchaser's personal use, without written permission.

© 1998 Copyright Equinox Technologies UK Limited. All rights reserved.

Atmel™ and AVR™ are trademarks of the Atmel Corporation
Keil C51™ and dScope™ are trademarks of Keil Elektronik GmbH
Microsoft, MS-DOS, Windows™ and Windows 95™ Windows NT™ are registered trademarks of the Microsoft Corporation
IBM, PC and PS/2 are registered trademarks of International Business Machines Corporation
Intel, MCS 51, ASM-51 and PL/M-51 are registered trademarks of the Intel Corporation

Every effort was made to ensure accuracy in this manual and to give appropriate credit to persons, companies and trademarks referenced herein.

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Contacting Equinox

Equinox Technologies UK Limited

3 Atlas House, St George's Square, Bolton, England BL1 2HB

Telephone Sales ..... : **+44 (0) 1204 529000**

Fax ..... : **+44 (0) 1204 535555**

E-mail ..... : **sales@equinox-tech.com**

Web site ..... : **www.equinox-tech.com**

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Contents

INTRODUCTION 1

PRODUCT OVERVIEW 2

IDE OVERVIEW 4
(Integrated Development Environment)

PK51 SYSTEM SUMMARY 8

PK51 SYSTEM COMPONENTS 9

EK51 SYSTEM SUMMARY 10

INSTALLATION OVERVIEW 11

SOFTWARE INSTALLATION 13

QUICK REFERENCE GUIDE 15

DEVICE SUPPORT 16

C51 APPLICATION PROGRAM EXAMPLES 19

APPENDIX 1 - C51 INTERRUPT SUMMARY 20

APPENDIX 2 - LIBRARY FUNCTIONS 21

TECHNICAL SUPPORT 25

RECOMMENDED READING 28

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Introduction

The Keil PK51 Toolset contains a comprehensive suite of code development tools for the 8051 microcontroller family. The package includes a powerful Integrated Development Environment (IDE) which encompasses a full 8051 Project Management System. The Project Manager integrates an editor, C compiler, assembler, software simulator and target debugger into one easy-to-use Windows environment. Keil PK51 supports authoring of source code for the 8051 in C, assembler and PL/M or a mixture of all three.

The Keil C compiler, C51, allows you to write programs in C and still get the efficiency and execution speed of assembly language. The compiler is capable of producing ANSI-C code, but also features a comprehensive suite of 8051 language extensions which allow you to access the full hardware resources of the 8051 architecture. The compiler allows you to directly access the on-chip special function registers (sfr's) of most 8051 8-bit derivatives by simply including the relevant file to describe the required microcontroller information. Other hardware-specific functions such as accessing port pins individually and handling interrupts are also supported.

It is entirely possible to write your complete project using C51 without ever resorting to assembler. Even time-critical code such as interrupt service routines can be optimised at the compilation stage so as to generate the most efficient code. The PK51 Toolset also features a Macro Assembler which can be used to write or import assembler source files. The environment supports linking of separate assembler and source files within the same project. Variables may be passed between C and assembly modules and vice-versa.

After the C51 and assembler source files have been compiled and linked together, the resulting code can then be imported into the 'Software Simulator' where it can be fully tested and debugged without the need for an actual target board. The simulator displays code in both high-level and/or assembler making it possible to see exactly what assembly code the compiler has generated. This testing is useful for verifying the operation of code and also when trying to find 'logical' errors.

The Keil PK51 Toolset is now available in four different packages from an evaluation version to the fully unrestricted version. A full upgrade path between versions is also available allowing you to evaluate the product in stages.

PK51 will allow you to:

- Author code ANSI-C
- Write code in assembly language
- Write code in Intel PL/M
- Compile/assemble and link both C and assembly language source files
- Verify correct operation of 8051 code using PC simulator
- Produce HEX files which are compatible with most device programmers and in-circuit emulators

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

PK51 Overview

The Keil PK51 Toolset consists of a comprehensive suite of code development tools for the 8051 family which are all accessed through the same easy-to-use Windows environment.

PK51 contains the following tools as listed below:

µVision
Integrated Project Management Environment

C51
Optimising ANSI-C Compiler

A51
Macro Assembler

BL51
Code Linker/locator

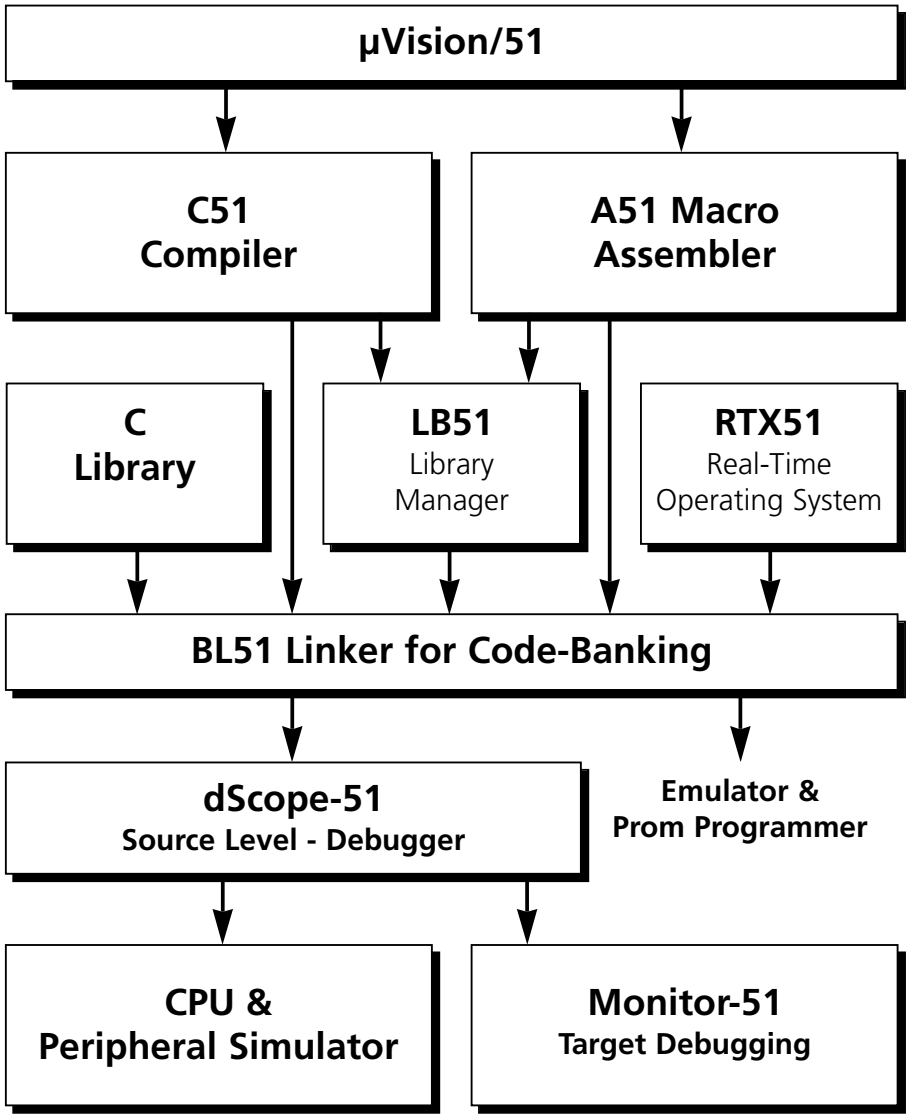
dScope (Software Simulator & Target Debugger)
Simulates CPU and associated peripherals

LB51 (Library Manager)
A suite of pre-written library C functions

Monitor-51
Target Debugger

PK51 Overview Continued

PK51 Tool Kit Overview



Please Note:

Some packages may not contain all of the above components see fig. 3 on page 9.

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

IDE Overview

µVision - Integrated C51 Project Management Environment

- Powerful integrated editor environment
- Support for multiple source files within a project
- Powerful MAKE utility - compiles only changed source files
- Supports external tools including Micro-Pro 51 device programmer
- Colour-coded syntax highlighting
- Interactive source code error correction
- Project-wide setup menus for tool options

dScope-51 - Software Simulator & Debugger

" The unparalleled 8051 Debugger"

- Ideal tool to verify correct operation of user code
- Supports PC simulation of the complete 8051 CPU core
- Provides source level debugging of user C51 programs
- User program symbolic information is available during simulation
- Supports 'watching' of user variables
- Allows single-stepping of C-source code in high-level and/or assembly language
- Provides extensive break-point facilities
- Full support for I/O ports, timers & interrupts
- Support for serial UART simulation via 'serial window'
- Performance analyser allows user code to be optimised
- Supports external 'signal' functions to test user program execution

IDE Overview Continued

C51 - Optimising Ansi-C compiler for the 8051 family

"The unsurpassed Industry Standard C Compiler"

- Generates optimised 8051 - specific code
- Flexible variable allocation with bit, data, bdata, idata, xdata and pdata
- Supports data types including bit, (signed/unsigned) char, int & long
- Comprehensive mathematical libraries
- Supports both memory specific and generic pointers
- Supports parameter passing including BIT variables
- Supports re-entrant functions (same function can be called from both the main and interrupt service routine)
- Interrupt and re-entrant functions can be directly coded in C51
- Direct support for SFR's and single BIT variables by name
- Comprehensive symbol and debug information available for use by dScope, EPROM Emulators etc.

A51 Macro Assembler

The A51 assembler is a macro assembler for the 8051 microcontroller family. It translates symbolic assembly language mnemonics into relocatable object code where the utmost speed, small code size, and hardware control are critical. The macro facility speeds development and conserves maintenance time since common sequences need only be developed once. The A51 assembler supports symbolic access to all features of the 8051 architecture and is configurable for the numerous 8051 derivatives.

BL51 Linker/Locator

- Combines one or more modules into one executable 8051 program
- Overlaying of local data variables greatly reduces the overall RAM requirements of many user programs
- Supports up to 64k of XDATA for storing external variables in RAM
- Code limit depends on package purchased

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

IDE Overview Continued

Project Based Development

Back in the old days of DOS development tools, it was necessary to run separate command line driven programs to compile, link and then produce a hex file. This was not only time consuming, but could also lead to a lot of compilation and linking errors due to typing errors.

The Keil µVision Integrated Development Environment (IDE) takes care of all file management for you, so all you have to worry about is actually writing code that works! The table below show the different file contained within a typical Keil C51 project.

Files contained within a typical µVision project

Extension	Example	Description
.prj	example.prj	**Project File:** *Contains names of all source files associated with the project and includes information for compiling, assembling & linking to generate an executable target program.*
.c	cfile1.c cfilen.c	**C Source File:** *This file is an ASCII text file containing a program written in C51. It is possible to have as many source files as are required. Eg. 1 to n*
.a51	a51file1.a51 a51filen.a51	**Assembler Source File:** *This file is an ASCII text file containing a program written in A51. It is possible to have as many source files as are required. Eg. 1 to n*
.h	Reg51.h Evalu8r.h	**Include (header) File:** *This type of file can be used to declare microcontroller-specific register information or as a convenient way of including variable declarations.*
.obj	cfile1.obj cfilen.obj a51file1.obj a51filen.obj	**Object File:** *When a C or assembler source file is 'compiled', the compiler translates the source into an object file.*
.lst	example.prj	**List File:** *A LIST file is created by the compiler when the project or a module within the project is compiled. The file is an ASCII log file of the compilation process and details any errors found.*
-	example	**OMF51 - Absolute Object File:** *This file has no file extension. This file contains the actual executable code after a project build. It also contains any symbolic information if the 'debug' options are enable within µVision.*
.m51	example.m51	**Map File:** *A MAP file is created by the compiler when the project or a module within the project is compiled.*
.hex	example.hex	**Intel Hex File:** *This is a standard output format which can be downloaded to many emulators or device programmers. The actual executable 8051 code is contained in an encoded format within this file.*
.ini	example.ini	**D-Scope Initialisation File:** *This file contains a script which dScope executes when launching a project.*

Figure 1

IDE Overview Continued

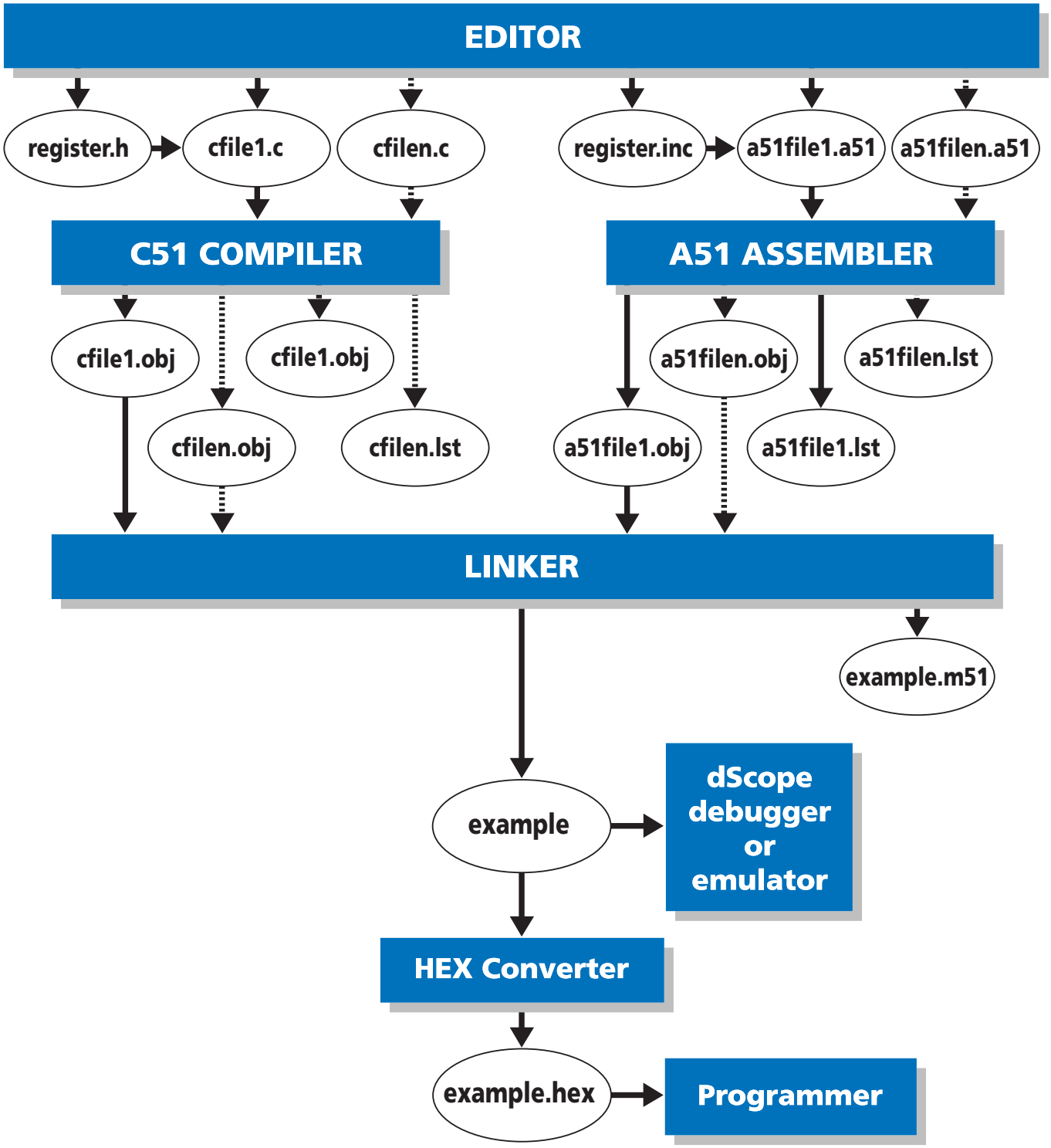


Figure 2

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

PK51 System Summary

Which package?

The Keil PK51 Toolset is now available in four different packages and can be supplied as part of an Equinox system or as an upgrade to an existing system.

The currently available packages are listed below. Fig. 3 shows the specifications of each system.

- **EK51-2K**
  This is an evaluation version of the PK51 Toolset which is capable of compiling up to 2K of user-generated code for 8051 derivatives using external code memory. It is NOT possible to use this package to compile code for 8051 microcontrollers which feature on chip code memory.

- **PK51-2K**
  This package allows you to compile up to 2K of user-generated code for most 8051 derivatives. It is possible to generate code which can be placed either in external memory or within on-chip code memory. This therefore makes the package ideal for writing small projects for any 8051 microcontroller which features on-chip code memory including OTP, EPROM and FLASH derivatives.

- **PK51-8K**
  This package allows you to compile up to 8K of user-generated code for most 8051 derivatives. It is possible to generate code which can be placed either in external memory or within on-chip code memory. Floating point libraries and the full Keil Reference Manual Set are included with this system making it ideal for developing large projects for many 8051 derivatives.

- **PK51-FULL**
  The fully unrestricted version of the PK51 Toolset allows you to compile up to 64K of user-generated code. It is possible to generate code which can be placed either in external memory or within on-chip code memory. Floating point libraries and the full Keil Reference Manual Set are included with this system making it ideal for developing very large projects for many 8051 derivatives.The full version also includes a 'Real Time Operating System' (RTOS) and access the DOS commandline utilities.

PK51 System Components

	EK51	PK51-2K	PK51-8K	PK51-FULL
SOFTWARE UTILITIES				
Code size (C51+A51)	2K External Only	2K Internal/External	8K Internal/External	Unrestricted Internal/External
C-compiler (C51)	Y	Y	Y	Y
Assembler (A51)	Y	Y	Y	Y
µVision Integrated Development Environment	Y	Y	Y	Y
Linker (BL51)	Y	Y	Y	Y
Intel Hex output	Y	Y	Y	Y
Simulator & debugger (dScope)	Y	Y	Y	Y
RTX-TINY (Real Time Operating System)	N	N	N	Y
LIBRARIES INCLUDED				
Small	-	Y	Y	Y
Compact	-	Y	Y	Y
Large	Y	Y	Y	Y
Floating point	N	N	Y	Y
DEVICE SUPPORT				
Generic 8051, 8052	Y	Y	Y	Y
Atmel 89S	N	Y	Y	Y
Dallas 80C320, 520 and 530	Y	Y	Y	Y
Philips 8xC750, 751 and 752	N	Y	Y	Y
Siemens 80C517	Y	Y	Y	Y
DEVICE SPECIFIC SUPPORT				
Dual Data Pointer Support	N	N	Dallas 320 / Atmel 89S	Dallas 320 / Atmel 89S
In-line assembler Support	N	N	N	Y
Max. Source Files	5	Unrestricted	Unrestricted	Unrestricted
AJMP/ACALL	N	Y	Y	Y
DOCUMENTATION				
8051/251 Evaluation Manual	N	Y	Y	Y
C51 Reference Manual	N	N	Y	Y
A51 Reference Manual	N	N	Y	Y
dScope Reference Manual	N	N	N	Y
8051 Utilities Manual	N	N	Y	Y
MISCELLANEOUS				
Windows 3.1 or above	Y	Y	Y	Y
DOS (command line)	N	N	N	Y
Security Dongle required	N	N	N	Y

Figure 3

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

EK51

EK51 - FREE Evaluation copy of PK51

- Allows evaluation of complete toolset
- Generates up to 2K of actual code!
- Compiles for external code memory only
- Can not be used for devices featuring on-chip code memory

The Evaluation Kit has the following restrictions:

- µVision Limitations: The µVision IDE limits your projects to 5 files and only edits 16K files or smaller.
- 2K-Limited Tools: The compiler, assembler, linker, and debugger are limited to 2K.
- Programs that generate more than 2K of object code will not compile, assemble, or link.
- The debugger only supports 2K files or smaller.

Startup Code: The startup code generated includes LJMPs. This means the code generated cannot be used in single-chip devices that support less than 2K of program space (like the Philips 750/751/752).

Title	Ver	Description	PC O/S	Download file	Size (bytes)	File type	Last Updated
EK51 Software	5.20	Keil EK51 Evaluation version of PK51 Toolset (generates up to 2K of external code)	Win 3.11 Win 95	3 discs: EK51D1.zip EK51D2.zip EK51D3.zip	1.26M 1.30M 0.03M	SEZ	-
EK51 User Manual	-	Keil EK51 User Manual in PDF format	-	dm51.pdf	736K	SEZ	-

Figure 4

How to download and install EK51 software:

Create a directory on your PC's hard drive for the installation files.

1 Download the following install disks from our web site:
EK51D1.zip
EK51D2.zip
EK51D3.zip

2 Unzip the contents of the zip file(s).

3 Run the Setup program, SETUP.EXE.

4 Follow the instructions displayed by the Setup program.

How to download and install EK51 Manual:

A manual covering the use of the EK51 software is available to download in PDF format. (see above)

Installation Overview

Introduction

This introduction explains how to set up an operating environment and how to install the software on your hard disk. Before starting the installation program, please verify that your computer system meets the minimum requirements and make a copy of the installation diskettes for backup purposes.

System Requirements

There are minimum hardware and software requirements that must be satisfied to ensure that the compiler and utilities function properly.

These are as follows:

- 100% IBM Compatible 386 or higher PC
- Windows 3.1 or higher (Windows 95 compatible)
- 4Mb RAM minimum
- Hard disk with minimum 6Mb free space

The C compiler and utilities require that you have at least 20 files and 20 buffers defined in your config.sys file. Additionally, you need enough environment space for the environment variables used by the C compiler (see figure 7).

Default Install Directory

The installation program copies the development tools into the sub-directories show in Fig. 5. The default base directory depends on which package you are installing.

Package	Default Install Directory
PK51-2K	\C51lite
PK51-8K	\C51
PK51-FULL	\C51

Figure 5

Directory Structure

Paths	Description
...\ASM	Assembler files
...\BIN	Executable files
...\Examples	Sample Applications
...\INC	C compiler include files
...\LIB	C compiler library files and startup code
...\MON51	Target Monitor files

Figure 6

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Installation Overview Continued

Environment Settings

The compiler and utilities require entries in the DOS environment table that specify the path to include files and libraries. In addition, you must include the ...\bin\ directory in your own path.

PATH	\C51\BIN	Specifies the path of the 8051 development tools
TMP	USER CHOICE	Specifies the path for temporary files generated for best performance, this path should be a RAM disk
C51INC	\C51\INC	Specifies the path where the standard C51 compiler tools are located
C51LIB	\C51\BIN	Specifies the path where the standard C51 compiler library files are located

Figure 7

Typically, environment settings are automatically installed in your autoexec.bat file by the installation program. If you wish to put these settings in a separate batch file, the environment settings must be entered as follows:-

```
PATH=C:\C51\BIN
SET C51=C:\C51\INC
SET C51LIB=C:\C51\LIB
```

Figure 8

Software Installation

The Keil PK51 Toolset features a straightforward installation program which, once launched, gives full on-screen prompts at every stage. As with any software package, actually getting up and running can be the most frustrating exercise. The list of installation hints below has been gathered from years of technical support for this product and should help prevent any installation problems.

Keil PK51

1 Is compatible with Windows 3.11 and Windows 95

2 Can be installed on a network drive and launched from a remote client machine

Installation hints

1 Avoid long path names - directory names and path names which have more than 8 characters for the installation path and for any source files
eg. c:\c51\examples . . . This is OK !
eg. c:\keil_c51_software\examples_15_04_98 . . . This causes linker problems !

2 Avoid directory names and path names which contain characters such as '~'

3 In windows 3.11, make sure that the 'Work exclusively in foreground' option in the 'Virtual memory settings' within 'Control Panel' is switched OFF

Number of installation disks supplied with each package

PK51-2K 2 disks, PK51-8K 2 disks & PK51-FULL 3 disks

Installation Procedure

From Windows 3.11 or Windows 95 environment

1 Insert Disk 1 into floppy drive eg a:

2 From the 'Start' menu, select 'Run..'

3 Type 'a:\setup.exe' or browse to the required drive and select 'setup.exe

4 The Keil installation program should now commence

5 Follow instructions and prompts given on screen

6 At the end of the installation, the software will ask you to close down Windows and restart your PC. This stage must be carried out to guarantee that all system files are updated correctly.

7 Connect Security Dongle (If required see fig. 9 on page 14 for details)

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Software Installation Continued

If you now re-launch windows
For Windows 3.11 users a program group called 'PK51-2K' should have been created. For Windows 95 users, the Keil toolset can be found from the 'Start' menu under 'Programs'.

µVision - Integrated Development Environment

dScope - Software Simulator & Debugger

readme - Latest release notes text file

A program group should now have been created.
For Windows 95 users, the Keil applications should now be available on the

Please ensure that you follow the latest instructions supplied when installing your software

Is a Security Dongle Required?

EK51	PK51-2K	PK51-8K	PK51-FULL
NO	NO	YES	YES

Figure 9

Quick Reference Guide

Memory Types

The C51 compiler fully supports the architecture of the 8051 and its derivatives. It provides access to all memory areas of the 8051. Each variable may be explicitly assigned to a specific memory space as detailed in fig. 10. For further information see page 24/25 of the "8051/251 Evaluation Kit" manual.

PK51 Memory types

Figure 10

Memory type	Description	Limit (bytes)
CODE	Program Memory	8k
RAM	Directly addressable internal data memory	128
XDATA	External Data memory	64k
IDATA	Indirectly addressable internal data memory	128

Function Libraries supplied with PK51

PK51 is supplied with a suite of function libraries for SMALL, COMPACT and LARGE memory models as outlined in fig. 11. A summary of all the C51 functions included can be found in appendix 2.

PK51 Function Libraries

Figure 11

Library file	Description
C51C.lib	Compact Model without floating point libraries
C51L.lib	Large Model Library without floating point libraries
C51S.lib	Small Model Library without floating point libraries
C51FPC.lib	Compact Model with floating point libraries
C51FPL.lib	Large Model Library with floating point libraries
C51FPS.lib	Small Model Library with floating point libraries

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Device Support

Processor include files

The Keil software tools support a wide variety of 8051 derivatives. In order to customise the compiler for a particular processor, it is necessary to declare all the registers, pin assignments etc. of the target processor in a 'register include' file. All register include files are named in the format 'device.h' and can be found in the C51\INC directory.

PK51 contains a comprehensive suite of register include files which are specific to Atmel, Dallas, Intel, ISSI, Philips, Siemens, Temic & Winbond microcontrollers (see table below). Generic include files for the 8051 and 8052 are also supplied. These should be used if code is to be entirely portable between different 8051 manufacturers.

dScope CPU driver models

dScope is a software simulator which is is capable of simulating the internal operation of many 8051 derivatives. In order to customise the simulator for a particular processor, it is necessary to load the relevant CPU driver model for the target processor. All CPU driver files are named in the format 'device.dll' and can be found in the C51\BIN directory.

PK51 contains a comprehensive suite of CPU drivers which are specific to Atmel, Dallas, Intel, ISSI, Philips, Siemens, Temic & Winbond microcontrollers. (see fig. 12) Generic CPU drivers for the 8051 and 8052 are also supplied. These should be used if the required model is not available.

For full instructions of how to specify a CPU driver see page 63 of the '8051/251 Evaluation Handbook'.

To update a new device into PK51:

1. Copy the new device.dll file into the C51\BIN directory
2. Copy the new device.h file into the C51\INC directory

Figure 12

Atmel microcontroller Part Code	C51 register include file		dScope Simulation Model	
	File Name	Fully Supported	File Name	Fully Supported
AT89C1051	at891051.h	YES	89c1051.dll	NO
AT89C2051	at892051.h	YES	89c2051.dll	NO
AT89C51/AT89LV51	at89x51.h	YES	89c51.dll	YES
AT89C52/AT89LV52	at89x52.h	YES	89c52.dll	YES
AT89C55	8052.h	NO	8052.dll	NO
AT89S8252	at898252.h	YES	8052.dll	NO

Future Atmel device support

Software updates for new microcontrollers will be periodically be made available for free download from any of the information contact points listed in the contact section.

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Device Support Continued

The Keil PK51 Toolset supports most 8051 derivatives which feature an 8-bit 8051 core. Support is also offered for derivatives with specific on-chip hardware such as extra timers, serial ports, RAM and EEPROM. The compiler now supports the Dallas 87C520 high-speed microcontroller core devices plus the Atmel 89S microcontrollers with on-chip EEPROM.

The table below shows the level of support offered for each 8051 derivative. This list is a summary of the popular devices supported and should not be considered as an exhaustive list.

		EK51	PK51-2K	PK51-8K	PK51-FULL
Maximum Code Size (C51+A51)		2K External only	2K Internal/External	8K Internal/External	Unrestricted Internal/External
ROMLESS 8031/8032					
Generic 8031	64K	YES	YES	YES	YES
Generic 8032	64K	YES	YES	YES	YES
Atmel					
AT89C1051	1K	NO	YES	YES	YES
AT89C2051	2K	NO	YES	YES	YES
AT89C51, AT89LV51	4K	NO	Up to 2K of code	YES	YES
AT89C52, AT89LV52	8K	NO	Up to 2K of code	YES	YES
AT89C55	20K	NO	Up to 2K of code	Up to 8K of code	YES
AT89S8252, AT89LS8252	8K	NO	Up to 2K of code Dual data pointer NOT supported	YES Dual data pointer is supported	YES Dual data pointer is supported
AT89S53, AT89LS53	12K	NO	Up to 2K of code Dual data pointer NOT supported	Up to 8K of code Dual data pointer is supported	YES Dual data pointer is supported
Dallas Semiconductor					
DS80C320 (ROMLESS)	?	YES External only	Up to 2K of code Dual data pointer NOT supported	YES Dual data pointer is supported	YES Dual data pointer is supported
DS87C520	8K	NO	Up to 2K of code Dual data pointer NOT supported	YES Dual data pointer is supported	YES Dual data pointer is supported

Figure 13 (Continued on page 18)

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Device Support Continued

		EK51	PK51-2K	PK51-8 K	PK51-FULL
Maximum Code Size (C51+A51)		2K External only	2K Internal/External	8K Internal/External	Unrestricted Internal/External
Philips					
87C51	4K	NO	Up to 2K of code	YES	YES
87C52	8K	NO	Up to 2K of code	YES	YES
87C51FA	8K	NO	Up to 2K of code	YES	YES
87C51FB	16K	NO	Up to 2K of code	YES	YES
87C51FC	32K	NO	Up to 2K of code	YES	YES
87C750	1K	NO	Soon	YES	YES
87C751	2K	NO	Soon	YES	YES
87C752	2K	NO	Soon	YES	YES
Intel					
87C51	4K	NO	Up to 2K of code	YES	YES
87C52	8K	NO	Up to 2K of code	YES	YES
87C51FA	8K	NO	Up to 2K of code	YES	YES
87C51FB	16K	NO	Up to 2K of code	YES	YES
87C51FC	32K	NO	Up to 2K of code	YES	YES
Siemens					
80C515	External	YES External only	Up to 2K of code	Up to 8K of code	YES
80C517(A)	External	YES External only	Up to 2K of code	Up to 8K of code	YES
Temic					
87C51	4K	NO	Up to 2K of code	YES	YES
87C52	8K	NO	Up to 2K of code	YES	YES

Figure 13 (Continued from page 17)

C51 Application Program Examples

Keil Examples - See page 71 (8051/251 Evaluation Kit Manual)

Several example programs have been included in the EXAMPLES directory. These files demonstrate how to use the project manager as well as how to use µVision and dScope to locate and correct errors/bugs in your source code. Please refer to the 8051/251 Evaluation Kit User's Guide for complete descriptions of these programs.

Appendix 1 - C51 Interrupt Summary

C51 Interrupt Overview

The 8051 architecture supports a number of interrupt sources. Each interrupt source has an associated address to which program execution vectors after the interrupt occurs. Keil C51 fully supports the 8051 interrupt structure, allowing fast interrupt service routines to be coded in C51.

Each interrupt is given a unique number in C51 and also has a pre-defined symbol name. This means that there is no need to remember individual interrupt vector addresses. This information is defined in the relevant processor register include file. Fig.14 below details the most common 8051/8052 interrupt vectors along with all the associated source, enable and priority flags.

Interrupt	Vector Address	SFR Register & bit position	Source flag	Enable	Priority	C51 Interrupt Number	C51 Interrupt Symbol
System Reset	0000H		RST			-	
External 0	0003H	TCON.1	IEO	EXO	PXO	0	IEO_VECTOR
Timer 0	000BH	TCON.5	TFO	ETO	PTO	1	TFO_VECTOR
External 1	0013H	TCON.3	IE1	EX1	PX1	2	IE1_VECTOR
Timer 1	0023H	TCON.7	TF1	ET1	PT1	3	TF1_VECTOR
Serial Port Transmit	0023H	SCON.1	TI	ES	PS	4	SIO_VECTOR
Serial Port Receive	0023H	SCON.0	RI	ES	PS	4	SIO_VECTOR
Timer 2	002BH	T2CON.7	TF2	ET2	PT2	5	TF2_VECTOR
External 2	002BH	T2CON.6	EXF2	ET2	PT2	5	EX2_VECTOR

Figure 14

Typical interrupt function declaration

```
void timer0 ( void ) interrupt TF0_VECTOR using 1
      {
          .......insert user code here
       }
```

The 'using' directive tells the compiler which register bank to use for variables for this interrupt function.

Appendix 2 Library Functions

aIntrinsic Functions (8051 Specific)

INTRINS.H - 8051 Specific Functions		Present (Yes/No)
unsigned char_crol_(unsigned char, unsigned char);	Rotate char left	✔
unsigned char_cror_(unsigned char, unsigned char);	Rotate char right	✔
unsigned int_irol_(unsigned int, unsigned char);	Rotate int left	✔
unsigned int_iror_(unsigned int, unsigned char);	Rotate int right	✔
unsigned long_lrol_(unsigned long, unsigned char);	Rotate long left	✔
unsigned long_lror_(unsigned long, unsigned char);	Rotate long right	✔
void_nop_(void);	NOP instruction	✔
bit_testbit_(bit);	JBC instruction	✔

Figure 15

MATH.H - ANSI Standard Functions

MATH.H - ANSI Standard Functions	Present (Yes/No)
int abs (int);	✔
float acos (float);	✔
float asin (float);	✔
float atan (float);	✔
float atan2 (float, float);	✔
char cabs (char);	✔
float ceil (float);	✔
float cos (float);	✔
float cosh (float);	✔
float exp (float);	✔
float fabs (float);	✔
float floor (float);	✔
long labs (long);	✔
float log (float);	✔
float log10 (float);	✔
float modf (float, float*);	✔
float pow (float, float);	✔
float sin (float);	✔
float sinh (float);	✔
float sqrt (float);	✔
float tan (float);	✔
float tanh (float);	✔

Figure 16

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Appendix 2 continued

STDIO.H - ANSI Standard Functions

STDIO.H - ANSI Standard Functions	Present (Yes/No)
extern char_getkey (void);	✔
extern char getkey (void);	✔
extern char*gets (char*, int);	✔
extern int printf (const char*, ...);	✔
extern char putchar (char);	✔
extern int puts (const char);	✔
extern int scanf (const char*, ...);	✔
extern int sprintf (char*, const char*, ...);	✔
extern int sscanf (char*, const char*, ...);	✔
extern char ungetchar (char);	✔

Figure 17

STRING.H - ANSI Standard Functions

STRING.H - ANSI Standard Functions	Present (Yes/No)
extern void *memchr (void *s, char c, int len);	✔
extern void *memccpy (void *dest, void *src, char, int len);	✔
extern char memcmp (void *s1, void *s2, int len);	✔
extern void *memcpy (void *dest, void *src, int len);	✔
extern void *memmove (void *dest, void *src, int len);	✔
extern void * memset (void *s, char c, int len);	✔
extern char *strcat (char *dest, char *src);	✔
extern char *strchr (const char *s, char c);	✔
extern char strcmp (char *s1, char *s2);	✔
extern char *strcpy (char *dest, char *src);	✔
extern int strcspn (char *s, char *set);	✔
extern int strlen (char *s);	✔
extern char* strncat (char *dest, char *src, int len);	✔
extern char strncmp (char *s1, char*s2, int len);	✔
extern char *strncpy (char *dest,char *src, int len);	✔
extern char *strpbrk (char *s, char *set);	✔
extern int strpos (const char *s, char c);	✔
extern char *strrchr (const char *s, char c);	✔
extern char *strrpbrk (char *s, char *set);	✔
extern int strrpos (const char *s, char c);	✔
extern int strspn (char *s, char *set);	✔

Figure 18

Appendix 2 continued

STDLIB.H - ANSI Standard Functions

STDLIB.H - ANSI Standard Functions	Present (Yes/No)
extern float atof (void *);	✔
extern int atoi (void *);	✔
extern long atol (void *);	✔
extern void *calloc (unsigned int, unsigned int);	✔
extern void free (void xdata *);	✔
extern void init_mempool (void xdata*, unsigned int);	✔
extern void *malloc (unsigned int);	✔
extern int rand (void);	✔
extern void *realloc (void xdata *, unsigned int);	✔
extern void srand (int);	✔

Figure 19

SETJMP.H - ANSI Standard Functions

SETJMP.H - ANSI Standard Functions	Present (Yes/No)
void longjmp (imp_buf, int);	✔
int setjmp (imp_buf);	✔

Figure 20

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Technical Support

Registration

Please fill out the 'Customer Registration Form' provided with your system and submit this to Equinox directly. Equinox will issue you a customer registration number which must be quoted when making any technical support enquiry to Equinox. Equinox can not provide technical support to unregistered users of our products.

Levels of technical support

Equinox provide a range of technical support services for the Keil PK51 Toolset. The level of support depends on the package you have purchased and also on whether you have purchased a 'Technical Support Contract' from Equinox. The level of technical support offered for each package is detailed below. A separate support contract may be purchased for PK51-2K and PK51-8K if more in-depth technical support is required.

PK51-2K	Installation support only
PK51-8K	Installation support only
PK51-FULL	Premium Support

Installation Support

After ordering either PK51-2K, PK51-8K or PK51-FULL, Equinox offer you 30 days of support from date of registration with a reaction time of 5 working days. Please note that this support can only be given by e-mail and/or fax.

Please send your enquiries to:
E-mail: install@equinox-tech.com
Fax: +44 (0) 1204 535555

Standard Support

Standard technical support is offered only via e-mail and fax with a response time of 48 hours. Equinox will attempt to answer any question relating to the general use of the PK51 environment. We can not, however, answer questions on how to write C51 or A51 source code or relating to user-specific hardware.
An automated e-mail service is available which will send you news of new update releases and device support enhancements.

Please send your enquiries to:
E-mail: pk51_support@equinox-tech.com
Fax: +44 (0) 1204 535555

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Technical Support Continued

Premium Support

Premium technical support is offered via telephone, e-mail and fax with a response time of 24 hours. Equinox will attempt to answer any question relating to the general use of the PK51 environment. We can not, however, answer questions on how to write C51 or A51 source code or relating to user-specific hardware. An automated e-mail service is available which will send you news of new update releases and device support enhancements.

Please send your enquiries to:
E-mail: pk51_premium@equinox-tech.com
Fax: +44 (0) 1204 535555

For Standard and Premium Support, a support contract must be signed before any help can be offered.

Fees for support services must be pre-paid.

Support Contract - Pricing Structure

Installation Support.....**FREE**

Standard Support.....**£200**

Premium support **£375**

Technical Support Continued

Keil Software - Technical Support

Keil offer a comprehensive range of technical support services for their products.

On-line Support Solutions Database

The 'Support Solutions Database' is the same database which Keil technical support engineers use to answer your questions. A copy of the support solutions database is maintained on the Keil web site. This database allows you to search on any keyword and can provide answers to many questions and problems with the minimum of user effort.

To access the 'Support Solutions Database', simply point your web browser at the Keil web site at www.keil.com and then select 'Support'

On-line Application Notes

For in-depth answers to complex questions, Keil Software provides a number of application notes you may use. Application notes provide you with detailed discussions of ways you can solve particular problems.

E-mail Support

One of the best ways to get technical support is to send Keil an e-mail. Please be sure to include any source code in the body of the e-mail. Try to avoid large program listings sent as attachments. They take longer to process.

In North and South America, e-mail Keil Software, Inc. in the USA at support.us@keil.com.

In Europe, Asia, Africa, and Australia, e-mail Keil Elektronik GmbH at support.intl@keil.com.

Telephone Support

You may always contact Keil directly via telephone.

In North and South America, contact Keil Software, Inc. in the USA at 972-735-8052.

In Europe, Asia, Africa, and Australia, contact Keil Elektronik GmbH at +49 89 456040 0.

FAX Support

You may contact Keil technical support groups via FAX:

In North and South America, FAX Keil Software, Inc. in the USA at 972-735-8055.

In Europe, Asia, Africa, and Australia, FAX Keil Elektronik GmbH at +49 89 468162.

EQUINOX TECHNOLOGIES
EQUINOX TECHNOLOGIES UK LIMITED
The Embedded Solutions Company

Recommended Reading

"8051/251 Evaluation Kit" - **Keil Software**
Supplied with all Starter Development Systems

"C Reference Guide" - **Kernighan & Ritchie**
Standard reference for the C language

"C for Dummies" - **Dan Gookin**
Good introductory guide to C
ISBN. 1-878058-78-9

"C The Complete Reference" - **Herbert Schildt**
Good overall C reference guide
ISBN. 0-07-882101-0

The Embedded Solutions Company

Equinox Technologies UK Limited reserves the right to change any information contained within this booklet without prior notice. E&OE
Terms and product names contained in this document may be trademarks of others. MCS-51 is a trademark of Intel Corporation.